Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of the Commission's Rules to	)	ET Docket No. 96-102
Provide for Unlicensed NII/SUPERNet	)	RM-8648
Operations in the 5 GHz Frequency Range	)	RM-8653
	)	

COMMENTS OF FUNDAMENTAL RESEARCH CORPORATION

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Fundamental Research Corporation (FRC), currently a small business employed in development of data compression, transmission, and manipulation technologies and expecting to enter the fields of computer hardware, operating systems, and telecommunications, submits its comments in response to the Notice of Proposed Rulemaking in response to the petitions filed by the Wireless Information Networks Forum ("WINForum") and Apple Computer, Inc. ("Apple") on May 15, 1995 and May 24, 1995 respectively. FRC applauds the Commission's decision to allocate 350 MHz of spectrum in the 5 GHz frequency range (specifically, 5.15-5.35 and 5.725-5.875 GHz bands) for use by unlicensed wireless NII/SUPERNet devices. FRC believes that such an allocation under appropriate regulation will spur the deployment of wireless local area networks (LANs) and longer-range community networks as envisioned by WINForum and Apple. However, in order to make the Petitioners' visions a reality, the proposed Part 15 amendments need to be corrected to address the following issues:

1. **The unlicensed NII/SUPERNet devices should be allowed to operate with up to 1 watt of power as proposed by Apple.**

The allowable power level of 1 watt will result in more efficient spectrum utilization since more devices operating at a variety of different power levels will be available on the market to suit different needs. As it stands today, no one can predict to the full extent how the spectrum will be used and the Commission should not place any limitations on development of the totally new industry. American computer industry had evolved in the absence of any regulations and as a result had made the United States the leader in the computer technology.

Several incumbent users of the NII/SUPERNet Band are concerned with the high power at which the unlicensed NII/SUPERNet devices will be allowed to operate. The incumbent users of the Band own licenses to the specific portions of the 5 GHz frequency range obtained at significant costs. The licenses held by the operators are their exclusive property and no matter how useful the unlicensed spectrum might be, the property should be respected.

However, the potential of interference caused by the unlicensed NII/SUPERNet devices to the licensed services is nonexistent. The "listen-before-talk" (LBT) etiquette will prevent a NII/SUPERNet device from transmitting in the NII/SUPERNet spectrum once a signal above threshold level is detected. Therefore, the "high-power" signal will not interfere with a signal coming from a licensed carrier. The Part 15 should be amended, however, to require NII/SUPERNet devices to monitor the complete radius of transmission associated with their power ratings. The antenna gain and height of such devices should be adjusted accordingly. FRC recommends the Commission to compose a table associating power levels, antenna gain levels, and antenna heights to the radii of transmission. A NII/SUPERNet device may not be required to monitor the entire radius of transmission if such a device uses a directional antenna.

Of more concern is the interference between the higher-power and lower-power devices, such as the community networks and local area networks. One acceptable solution to the problem is to limit high-power operations to the Upper 5.725-5.875 GHz NII/SUPERNet Band ("Upper Band"), leaving the Lower 5.15-5.35 GHz NII/SUPERNet Band ("Lower Band") to LANs. Such appropriation would separate short- and long-range operations and eliminate any interference. However, in some areas the potential LAN users might be nonexistent, and to prohibit any community networks operations from operating in the Lower Band will result in 200 MHz of unused spectrum while the Upper Band will be overloaded. The solution to this problem is presented below.

FRC recommends the Commission to create "Power Allowances" paragraph of the Subpart E of the Part 15 of title 47 of the Code of Federal Regulations. The paragraph should:

***(a)* define maximum allowable power levels for low- and high-power devices.**

Low-power devices are defined as devices operating at or less than 0.3 watt (or power level adequate for transmissions up to 300 meters).

* Some parties might state that LAN transmissions over such distances are not necessary. However, the purpose of the unlicensed devices is to provide flexibility. The user(s) will decide over what distances deployed devices will transmit. The Commission should pave the way for innovation, product variety, and competition.

High-power devices are defined as devices operating at powers greater than 0.3 watt (or power level adequate for transmissions over 300 meters) but below or at 1.0 watt.

* The concern of interference was addressed previously.

***(b)* place regulations on high- and low-power devices to eliminate their interference.**

High-power devices must operate in the Upper Band. Only in case of the Upper Band's total unavailability may a high-power device seek to transmit in the Lower Band.

Accordingly, low-power devices must operate in the Lower Band. Only in case of the Lower Band's total unavailability may a low-power device seek to transmit in the Upper Band.

Total unavailability is defined as a condition of a Band at which a NII/SUPERNet device is unable to transmit at any portion of the Band for 1 second or the time it takes the device to scan the entire spectrum twice.

After transmitting for a total of 1 second in a Band traditionally not assigned to it, a NII/SUPERNet device must attempt to transmit in its traditionally assigned Band. Only in case when such an attempt fails may the NII/SUPERNet device seek to transmit in the non-assigned Band. The device may add 1 second to the time it is allowed to transmit in the Band traditionally not assigned to it for each failed attempt to transmit in the traditional Band.

2. **The provisions should be made for longer-range community networks proposed by Apple.**

The main purpose of the unlicensed spectrum is to give the end users flexibility in deploying telecommunications technologies to satisfy their internal needs, especially when wired or licensed-wireless services prove prohibitively expensive, burdensome, or both. Apple had presented enough evidence to confirm that no other existing or currently proposed services are adequate for community networks operations. From Apple's Petition for Rulemaking and the great number of comments, substantial evidence was presented to prove the unlicensed NII/SUPERNet technology essential to such public entities as schools, libraries, hospitals, and local governments.

The Commission's concerns regarding high-power operations of such networks are understandable. However, the potential for interference to licensed operators of the spectrum is nonexistent as stated in section 1. The appropriations for the high-power devices associated with community networks should be made in the "Power Allowances" paragraph as proposed in section 1. The minimal regulations imposed by the Federal Communications Commission should not discriminate between the NII/SUPERNet devices based on the transmission range. The power level regulations of such devices will play their role in maximizing efficiency of the spectrum and minimize interference.

FRC notes that the Upper Band is the ideal part of the spectrum for community networks operations providing that such operations are allowed on unlicensed basis (comments are presented below). Data transmissions via telephone lines are very limitational in terms of transmission rates. For current graphics and audio intensive computer applications the allowable rates prove inadequate. The relatively high-speed ISDN and T1 lines, however, cannot be afforded by majority of low-budget entities, including libraries and schools. Although the proposed spectrum above 40 GHz provides opportunities for extremely fast transmissions, no technology currently exists to utilize the millimeter spectrum on cost-effective basis. PCS services are out of the question since PCS services are to be provided by licensed providers. The original premise for the

allocation of the NII/SUPERNet spectrum is to allow the end users to bypass service providers not fulfilling their needs. This does not preclude licensed PCS-providers from making their services available. They would only have to face competition from unlicensed 5 GHz spectrum users to start improving quality and reducing their service fees. Unlicensed PCS spectrum is inadequate because it is too narrow to accommodate the new multimedia applications and large enough number of users.

3. Licensing of any portion of the NII/SUPERNet spectrum should be prohibited.

FRC believes that licensing of any portion of the NII/SUPERNet spectrum will impede the deployment of technologies potentially beneficial to low-budget as well as high-budget entities since licensing comes with a variety of restrictions and prolonged administrative procedures.

To license the spectrum would mean to violate the original premise for allocation of the NII/SUPERNet spectrum as presented by Apple and WINForum.

Licensing of the spectrum impels the licensee to develop new technologies to provide commercial services in order to secure return on the investment put into an acquisition of the license. The licensee becomes a service provider and decides what capabilities his service would possess and what capabilities would be left off as commercially not feasible. If licenses are to be sold to such entities as libraries and schools, they would have to charge the users of their networks for connection time in order to recover the investments put into obtaining licenses. Under this clause, the access to the National Information Infrastructure (NII) will be limited to those who would be able to pay for such services. The society would be divided into information "haves" and "have nots," as predicted by Apple and many others. Therefore, the goal set by the Administration to provide access to the Information Superhighway to everyone across income levels and different walks of life will not be fulfilled. There is no hesitation in granting unlicensed status to the LAN operations. The subject of licensing concerns rather high-power services, such as community networks. If the Commission decides to grant free licenses to low-budget entities, the issue of such organizations would be resolved. However, the Commission may not grant free licenses to low-budget organizations and deny them to anyone else. Such coordination would violate equitable access to the spectrum. The low- and high-budget organizations will use the same equipment to construct long-range networks. If the concern is the issue of interference, there is no distinction between low- and high-budget organizations. However, the issue of interference is overstated. Under the power regulations proposed above, there would be no danger of interference caused by high-power devices to low-power devices. Therefore, to ease the operations in the NII/SUPERNet spectrum, all types of devices must be allowed to operate on equitable unlicensed basis.

FRC notes that NII/SUPERNet devices will use different modulation techniques than devices currently used in the spectrum. NII/SUPERNet devices transmit only for extremely small fraction of a second. As soon as such a device detects a signal above the threshold level, it immediately seeks to transmit in unused part of the spectrum. Therefore, the high power of such transmitting device does not present concern since there is no interference of signals coming from incumbent licensed and NII/SUPERNet unlicensed carriers at any given time. The issue of sharing between high- and low-power NII/SUPERNet devices was resolved in section 1.

FRC also notes that it is totally unnecessary to put a middleman-service provider (even if such a provider is impelled to make its network suitable for libraries, etc. on cost-effective basis because of the investment put into the license) between the users and such entities as libraries, local governments, or other potential providers of material available through community networks. Libraries, local governments, and other entities will be able to provide network services on their own using a variety of unlicensed devices permitted to operate at adequately high powers (up to 1 watt). Moreover, commercial service providers over time will increase connection rates to their networks because the users will have no choice in selecting a different service provider since all of the spectrum will be licensed away. Such situation occurred in the telecable business when in the absence of competition telecable companies started raising service fees. FRC also notes that if any portion of the NII/SUPERNet spectrum is to be licensed, LAN devices must be prohibited from operating in such licensed portions of the spectrum throughout the entire territory of the United States because it would be absurd to program a LAN device so as to allow transmission in one geographical area and prohibit it in another such area. Even if a licensed band would be uniform throughout the United States, in some areas community networks might prove unnecessary and the to-be-licensed portion of the spectrum will remain unused while the LAN spectrum might be overloaded — very inefficient use of the spectrum. Moreover, the spectrum will remain unused in areas (mainly rural) where profit-oriented licensees will not see a potential of quick return on the investment. Libraries and other desiring entities must be allowed to provide community networks on the "right here-right now basis," free of licensing restrictions or service provider's charges. Only within unlicensed free-for-all spectrum libraries and other entities will be able to provide community services envisioned by the Administration.

4. **Federal Communications Commission must not impose or endorse any type of protocol for operations of NII/SUPERNet devices developed by any industrial body, including a representative industrial body, besides the minimal rules specified in 47 C.F.R., Part 15, Subpart E.**

In their Petitions for Rulemaking, Apple and WINForum stated that a representative industrial body composed of information and telecommunications firms should be responsible for development of a protocol for operations of NII/SUPERNet devices. Apple and WINForum also proposed for the Commission to adopt such standard as a part of its regulations.

Although such a measure may foster interoperability of devices, FRC stringently opposes any government-imposed standard. Under no circumstances should the Commission impose an operating standard or endorse any standard adopted by any entity which goes beyond the scope of Part 15 proposed amendments.

(a) Since the participation in development of the standard would be generally limited to the incumbent large corporations, small businesses will be excluded from participation in completely new field of the telecommunications marketplace. The Commission should not forget the early days of the computer industry. The companies that had really made a difference were small businesses run by innovators. No standards existed, therefore there were no limitations on ingenuity and progress. Large corporations must not have monopoly on the emerging new market.

(b) If, however, every small business in the nation is invited to participate in development of the standard, which is very unlikely, only a part of the problem will be solved. Many companies that might enter the NII/SUPERNet market do not even exist at this point of time. Neither the Commission, nor any representative industrial association can predict the level of ingenuity of those yet unborn businesses. The Commission must not, therefore, prevent any of such companies from seizing opportunity to introduce new technologies into the world. The consumers will be free to choose what type of technology fits their needs. Market forces will be responsible for choosing any particular standard since unpopular goods have tendency to die out quickly.

(c) The "tragedy of the commons" will not occur because the basic LBT protocol proposed by the Commission along with the power regulations proposed by FRC in section 1 will ensure the availability of the spectrum for any use at any given time. Potential for interference between NII/SUPERNet devices will be nonexistent. Therefore, it is allowable to permit "a mix of incompatible users with mutually exclusive operating characteristics [1]" as long as the devices deployed are up to FCC LBT and power regulations.

5. **No preferences should be given to packet-based transmissions.**

No part of the FCC regulations should mention any provisions regarding packet-based transmissions in the NII/SUPERNet spectrum. Based on the LBT minimal protocol such transmissions are assumed and are subject to limitations imposed by the maximum time a NII/SUPERNet device may transmit before starting to monitor its transmission window once again. However, such an assumption should not be an obstacle to any new technology, which it would definitely become if packet-based transmissions would be imposed by the specific FCC regulations.

6. **No preferences should be given to either centralized or a distributed control scheme.**

Apple proposes to prohibit any centralized control-based operations in the NII/SUPERNet spectrum [2]. FRC opposes such a provision since it would become a limitation to the advances in the NII/SUPERNet technology. The end users should have flexibility regarding what type of equipment to deploy. The centralized control scheme might be extremely useful in many situations so as to tie client devices to a single server in a library or a classroom of the future. Apple's concern with centralized control is understandable since in most instances users are forced to pay connection fees to a central regulating entity. However, a variety of technologies emerging on a competitive basis would give consumers choice, which would guarantee that the consumers will not overpay for any service or device. Moreover, any centralized control between devices would have to be established on a consensual basis since LBT sharing protocol will allow for equitable access to the spectrum. No provisions regarding centralized/distributed use of the NII/SUPERNet spectrum should be included in any portion of the FCC regulations.

7. **No provisions should be made regarding channelization.**

WINForum had proposed that the NII/SUPERNet spectrum be subdivided into channels to transmit data at very high rates.

FRC opposes any channelization of the spectrum. FRC believes that such channels would constitute nothing more than a wasted portion of spectrum when very high rate (VHR) data transmissions are not needed. However, transmitting and receiving devices may divide spectrum into imaginable channels (subject to the communications protocol of such devices which must not be specified or endorsed by the Commission) in areas where VHR transmissions are sought. Some parties might argue that a mix of incompatible devices will make the spectrum unusable. FRC holds that such concerns are overstated. All NII/SUPERNet devices must follow basic LBT protocol which insures sharing of the spectrum on equitable basis. Thus, while one device is "quiet," another device is free to transmit. VHR transmissions in general would be used for short-range communications and, therefore, will be deployed by the same user or a group of related users. Thus, they are likely to use compatible devices. FRC notes that an innovative manufacturer will not make the VHR channels of his device hardcoded and not a subject to change. The Commission's regulations should foster a variety of technologies. Manufacturers might produce devices with different transmission rates at according prices. Market forces will select against inferior VHR transmitters. Thus, manufacturers will compete to produce better products. Some manufacturers might choose to make their devices compatible with European HIgh PErformance Radio LAN ("HIPERLAN") standard. Nothing precludes them from doing so as long as the devices follow Federal Communication Commission's minimal regulations (i.e., LBT protocol).

In its Notice of Proposed Rulemaking the Commission had requested comments regarding channel bandwidth limits and the number of channels a NII/SUPERNet device may use at any given time. FRC notes that the channelization scheme must not be provided and a NII/SUPERNet device should be allowed to grab up to entire NII/SUPERNet spectrum, subject to FCC minimal regulations (i.e., LBT protocol and power regulations).

8. **LBT protocol, out-of-band emission regulations, safety requirements, and minimum modulation efficiency (1 bps/Hz) should be established as currently proposed by the Commission.**

The only exception is the LBT protocol. Provisions should be made for high/low power devices operating in parts of the spectrum traditionally not assigned to them (refer to section 1).

9. **ISM devices operating in the Upper Band on unlicensed basis should be required to operate according to NII/SUPERNet minimal regulations.**

Unlicensed ISM devices should be required to operate under the same guidelines as unlicensed NII/SUPERNet devices to promote efficiency in the spectrum usage. Since NII/SUPERNet devices will provide consumers with services of importance equal to ISM services, ISM and NII/SUPERNet devices should operate at the same level of priority. FRC notes, however, that a slight preference might be given to the ISM devices since such devices are currently incumbent to the spectrum. Such relaxations of regulations, however, must be limited to only slightly increased time an ISM device may transmit uninterruptedly.

10. Operations in the NII/SUPERNet spectrum should be based on Part 15 regulations.

FRC believes that protected "Part 16" regulation will infringe on the legal rights of the incumbent licensees. FRC believes that the Commission may not legally allow NII/SUPERNet devices cause interference on licensed services thus forcing licensed devices to accept interference.

However, "Part 16" paradigm, as proposed by Apple, should be established in unlicensed spectrum above 40 GHz since no licensed operators of that portion of the spectrum exist. The Commission should reserve the millimeter spectrum to provide opportunities for unlicensed protected operations.

Fundamental Research Corporation reiterates that the Commission's regulations must not go beyond the scope of defining basic LBT protocol, power levels, antenna gain, out-of-band emissions, safety levels with respect to human exposure to radio frequency electromagnetic fields, and minimum modulation efficiency requirement. Any additional provisions will be totally unnecessary and will be an obstacle to progress. The Commission must not endorse any standards promoted by the industry which complement minimal FCC regulations. Operations in the NII/SUPERNet spectrum must be conducted on unlicensed basis to ensure spectrum availability for every possible utilization.

FRC urges Federal Communications Commission to adopt all necessary measures as they are presented in this document to open the gates for the next generation technologies.

Respectfully submitted,

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[1] Notice of Proposed Rulemaking at 15.
[2] Apple Petition at 25-27.